

Scoliosis conservative treatment: A review of literature

ABSTRACT

Background: Scoliosis is defined as lateral curvature of the spine which is also associated with a change in the curves in sagittal plane and vertebral rotation. Various types of conservative treatment approaches have been recommended for the patients with scoliosis. The aim of this review article was to introduce the various methods of conservative treatment which can be used for the patients with scoliosis.

Methods: A search was done in some databases including PubMed, ISI Web of knowledge, Google scholar, Ebsco, Embasco, and Scopus. Some keywords such as conservative treatment, orthosis, brace, exercise, and physical therapy were used in combination with scoliosis. As the aim of this paper was to introduce the conservative methods, no quality assessment was done in this review study.

Results: Forty papers were found on various conservative treatments approaches which have been used for the patients with scoliosis, in which most of the papers focused on different designs of braces. There were a few studies on other interventions such as wedge, functional electrical stimulation, and yoga.

Conclusion: Various treatment approaches have been used to treat scoliosis based on conservative approach. It is suggested that the efficiency of various methods be evaluated based on available literature.

Keywords: Conservative approaches, scoliosis, treatment

INTRODUCTION

Scoliosis is a three-dimensional deformity of vertebral column which is defined mostly based on lateral curvature of the spine.^[1,2] It is divided into structural and nonstructural scoliosis (postural).^[3] Structural scoliosis can be further divided into idiopathic (cause known) and nonidiopathic (cause unknown). The incidence of scoliosis varies in different countries between 2% and 13.6%.^[4,5] The main cause of scoliosis is not well understood. However, some reasons such as genetics, growth, hormonal dysfunction, bone mineral density change, abnormalities in body part tissue, abnormal platelet calmodulin levels, biomechanical factors, and central nervous system abnormalities influence the incidence of this disease.^[6]

Various treatment approaches have been used for the patients with scoliosis, especially for adolescent idiopathic scoliosis (AIS), including observation and monitoring, use of braces, exercise, yoga, acupuncture, and surgery.^[7-10] The amount of effectiveness

of the aforementioned methods depends on severity of the curve, age of the subject, and type of the curve.^[11,12] Unfortunately, most treatment approaches vary from region to region and may depend on preference and experience of physicians. The aim of this review is to introduce various conservative treatment approaches which have been used for the patients with scoliosis based on the available literature.

METHODS

A search was done in some databases including Google scholar, PubMed, ISI Web of knowledge, Ebsco, and

MOHAMMAD TAGHI KARIMI^{1,2}, TIMON RABCUK³

¹Rehabilitation Sciences Research Center, Shiraz University of Medical Sciences, Shiraz, ²Musculoskeletal Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ³Department of Civil Engineering, Bauhaus University, Weimar, Germany

Address for correspondence: Dr. Mohammad Taghi Karimi, Rehabilitation Sciences Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.
E-mail: karimi@rehab.mui.ac.ir

Access this article online	
Website: www.jcvjs.com	Quick Response Code 
DOI: 10.4103/jcvjs.JCVJS_39_17	

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Karimi MT, Rabczuk T. Scoliosis conservative treatment: A review of literature. J Craniovert Jun Spine 2018;9:3-8.

Embasco. Some words such as conservative treatment, exercise, physical therapy, orthosis, and brace were used in combination with scoliosis. The first selection of the papers was based on the following criteria:

1. The paper published in English
2. Papers focused mostly on conservative treatment and aforementioned keywords.

The second selection of the paper was based on titles and abstracts. The final selection of the papers was done based on the content of the full text to address the research question of interest.

RESULTS

Based on the aforementioned keywords, 110 papers were found. Forty-five papers were selected in screening based on screening criteria. Finally, 37 papers were selected, in which 6 papers focused on exercise and physical therapy, 25 papers on braces, and 3 on acupuncture, and 2 on functional electrical stimulation (FES). There was also one paper on use of shoe and insole on scoliosis.

Selected orthoses for treatment of scoliosis (AIS) can be categorized based on the length of the brace, time of brace use, and structure of the orthosis (stiffness of the material).^[13] Based on the length of the brace, it is possible to divide the braces into cervico-thoraco-lumbo-sacral and thoraco-lumbo-sacral orthosis. Based on the material of the braces, the available orthoses can be further divided into rigid and soft orthosis.^[14,15] Figure 1 summarizes the main orthoses designed for the patients with scoliosis. Regarding the exercise which can be used for scoliosis, they can be further divided into traditional and new approaches. Figure 2 shows the exercises used for the patients with IAS. There were only 3 papers on acupuncture, 2 papers on FES, and 1 paper on Yoga.

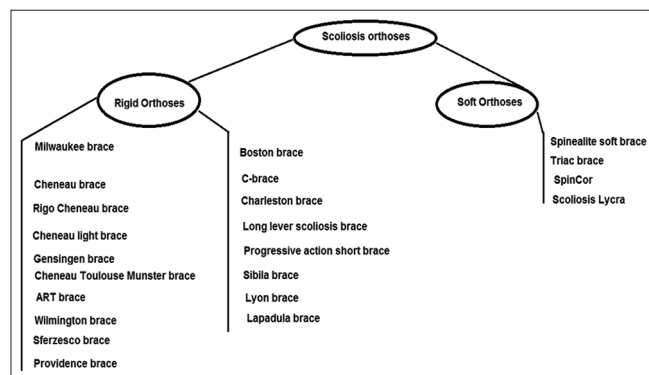


Figure 1: Various designs of orthosis used for conservative treatment of scoliosis

DISCUSSION

There is no doubt that scoliosis is one of the musculoskeletal deformities which mostly has an unknown origin. Various treatment approaches have been recommended for the patients with scoliosis deformity. The aim of this review was to categorize and to introduce various conservative treatment approaches used for the patients with scoliosis.

Braces used for scoliosis

Actually 25 papers were found on this topic. It should be emphasized that the aim of this article was only to introduce the orthoses not to compare their performances. As can be seen from Figure 1, the spinal orthoses can be divided into rigid and soft orthoses based on the structure of the orthosis.

Milwaukee brace

One of the commonly used high profile orthoses is Milwaukee orthosis. This is the first modern orthosis designed to treat spinal deformities. It was developed by Blount and Schmidt for postoperative treatment of postpolio scoliosis.^[16] This orthosis consists of pelvic section (which is mainly made from plastic), anterior and posterior uprights, and neck ring with throat mold anteriorly and occipital pads posteriorly. It is used mostly for the patients with apex of curve above T8.^[16] Another types of braces used for scoliosis are TLSOs which were first applied by Watts team for the patients with progressive AIS and curve apex below T8.^[17]

Boston brace

Actually, it is the most common used braces in North America, which was developed by John Hall and William Miller at Boston children Hospital in 1972. Now, this brace is produced commercially in six different sizes to reduce manufacturing time and cost. This is a posterior opening TLSO which passively correct the scoliotic curve.^[18]

Cheneau brace

This brace was introduced by Dr. Jacques Cheneau in the sixth decade. However, officially was presented in 1979

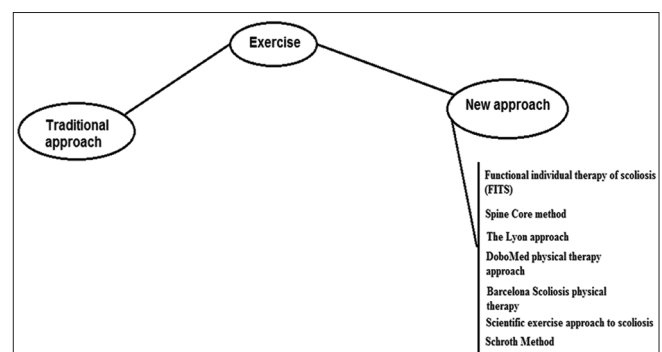


Figure 2: The physical therapy approaches used for scoliotic patients

in Bratislava. It has been shown that this orthosis has two mechanisms of actions including active and passive. Although the aim of orthotic treatment of scoliosis is curve progression control, Cheneau brace seems to correct the curvatures in some cases.^[14,19-21]

Rigo Cheneau brace

This brace was developed by Rigo Manuel in the early 90s. This brace is mostly recommended for the patients with mild to moderate juvenile scoliosis. It is based on concept of equilibrium at L4/L5 level.^[14,22,23] The Cobb angle correction of the main curvature is considered to be set at 53.7%. However, in the patients with a single long dorsal curvature, the curve correction is set at 76.7% and 55% in axial rotation cases.^[14]

Cheneau light brace

This brace was developed by Hans-Rudolf Weiss in 2005 to solve the problems of the previous designs.^[23] The design of this orthosis was based to make the orthosis available immediately and to make its adjustment and modifications very easily.^[24]

Gensingen brace

This brace was also developed by Weiss, which is based on Cheneau light brace.^[14,25] It is based on computer-aided design/computer-aided manufacturing technology (CAD-CAM). This is used mostly for the curvature exceeding 50°, which cannot be managed by other orthoses.^[25]

Cheneau-Toulouse-Munster brace

This brace is actually a TLSO with front opening. It applies specific pressure on torso to modify scoliotic curve and to prevent curve progression. It is recommended to use this orthosis particularly at night for low curvature (Cobb angle <30).^[26]

Triac brace

In contrast to other previous orthoses, this brace provides a dynamic correction force to correct scoliosis. Due to the location of the hinge section of the orthosis, this orthosis can be only used for curve below T11.^[27-29] The name of Triac comes from three C's including comfort, control, and cosmesis. The main point of the design of this orthosis was that the brace follows the motion of the patients. The interesting point regarding this orthosis is that the immediate correction of 22% can be achieved for primary curve and 35% for the secondary curve.^[27]

C-brace

Actually, this brace acts on single curve deformity and the design of the brace allows trunk movement, and hence, patients have more comfort while wearing the brace.^[30]

Scoliosis Lycra orthosis

This orthosis is used for the patients with neurological scoliosis. In this orthosis, a simple panel was added on the convex side of the brace to decrease the progression of the curve. Use of this orthosis is mostly recommended for the patients with cerebral palsy.^[31]

SpineCor orthosis

Actually, this is a dynamic orthosis which was developed in 1992–1993. The design of this orthosis is based on active biofeedback mechanism. The effectiveness of the SpineCor brace has been recommended for mild and moderate curves.^[32,33]

Charleston brace

This is a custom-molded spinal orthosis which holds the patients in overcorrected position. This brace seems to alter the natural history in retrospective studies with 5–10 h wearing time.^[34,35]

Long lever scoliosis brace

This orthosis was designed to treat large translational displacement associated with idiopathic scoliosis. The amount of the force required to stabilize the scoliosis curve decreases follow the use of long lever arm system.^[36]

Providence brace

This is also an orthosis which can be used during night. This brace puts the spine in an overcorrected position by application of the opposing forces. It is designed especially for curvature abnormalities.^[37,38]

Sforzesco brace

This brace was named in honor of the Medieval Sferza family in 2004 to avoid casting procedure, especially for the worst patients based on SPoRT (symmetric patient-oriented, rigid three-dimensional, active) concept of bracing. It is constructed from polycarbonate in two pieces which connected in anterior and posterior sides by a closure and a vertical aluminum bar, respectively.^[39]

Lapadula brace

This has the same structure as Sforzesco brace which is made from polycarbonate. The only difference was that Lapadula brace does not have the upper plastic part over the breast. It is also recommended to be used for the patients with hyperkyphosis and scoliosis.^[40]

Sibilla brace

This orthosis has the same structure as Lapadula brace and also made from polycarbonate sheet.^[40]

Dynamic derotational brace

This orthosis was designed and used by surgeon and spine unit of KAT orthopedic Hospital in Athens, with collaboration of Mr Nikolas Vastatzidis of Athen.^[41] Actually, this is a modification of Boston limited pressure, with addition of a system of light and slightly flexible blades made of aluminum. The results of the study of this brace showed that the brace not only restrict the progression of the curve but also correct it. It can be produced based on traditional cast method or use of CAD/CAM technology.^[41]

Progressive Action Short Brace

It is a custom-made TLSO introduced by Dr. Lorenzo Aulisa at Institute of orthopedic Catholic University. The brace is based on principle that constrained spines can achieve the correction through the use of inverting the abnormal loads distribution during growth.^[8]

Spinealite soft brace

This orthosis is also called CMCB brace (Correct Monocoque Carbone respectant la Respiration). This monoshell brace was developed by Lecanto society at the center des Massues in Lyon, in 1997. The pads of the brace in contrast to the pads of Lyon are mobile and more comfortable. This is a light brace reinforced by carbon blades and implemented without prior casting.^[42]

ART brace

Actually, after the development of CAD/CAM modeling, most of the braces have been developed by use of this system. In 2013, the new generation software (OrthenShape) allowed the overlay of different CAD/CAM modulus. The brace which was produced by the use of this technology, based on Lyon approach, is called ART brace. ART is the acronym for asymmetrical, rigid, torsion brace. The name was created by Stefano Negrini, the inventor of Sforzesco brace.^[43]

Lyon brace

Actually, Lyon brace created in 1947 by Pierre Stagnara to be adjustable, active, decompressive, symmetrical, stable, and transparent. It is possible to adjust the orthosis up to 7 cm of growth. It was made of polymethyl methacrylate which is transparent to monitor the skin conditions.^[9,44] The design of this brace is based on stretching of the ligaments of the spine to a certain point for a prolonged period by the use of plaster cast for 4 weeks. After that, the brace can be used especially during night to maintain viscoelastic level of the structure. The indication of use of this orthosis is the same as other orthoses. However, it is recommended to not be used for juvenile and infantile scoliosis to avoid a tubular thorax and also for those with severe thoracic lordosis for whom the treatment is mostly surgical.^[44] It is also recommended to not be used for those with major

psychological reactions and those with nonacceptation of the plaster cast.

Wilmington brace

This brace was designed by G Dean Mac Even to improve patients' compliance by making the brace less bulky and light weight compared to other braces. Actually, it is a custom-made TLSO orthosis from orthoplast. The design of this orthosis is the same as body jacket with an anterior opening. There are some adjustable straps to secure the orthosis. It is recommended to wear the orthosis as full time (23 h per day).^[45-47]

It should also be emphasized that the scoliotic brace can be categorized into soft and rigid orthoses. Figure 2 shows the classification of the braces based on structure. It is also possible to classify the scoliosis brace based on the time of wear.

Exercise

Another type of conservative treatment which is recommended for scoliotic patients is exercise. Beside of the routinely used exercise for scoliosis, some especial approaches have prescribed for the patients with scoliosis which can be mentioned as following.

Functional individual therapy of scoliosis

It is based on inclusion of many elements selected from variety of therapeutic approaches that have been adapted from a different treatment concepts.^[48] This method was created in Poland, which was aimed to improve postural problems and scoliosis. Actually, this is a method of diagnosis and therapy for idiopathic scoliosis. It can be used to correct scoliosis, a supportive therapy to bracing, preparation of children for surgery, and may be used after surgery to correct shoulder and pelvic girdles.^[48]

SpineCore method

It is a postural reeducation method which consists of combinations of corrective movement and global muscles rebalance exercise.^[49,50]

The Lyon approach

Lyon approach is a method of physical therapy which is used in combination with Lyon brace. Three main parameters are considered with this approach including patient age, postural imbalance, and Cobb angle.^[11]

Dobomed physical therapy approach

It should be emphasized that this method was also developed in Poland that addresses both trunk deformity as well as respiratory function impairment. This method requires a high degree of patient cooperation. Therefore, it is not recommended for children.^[11]

Barcelona scoliosis physical therapy

This method of treatment is based on this assumption that scoliosis posture and soft tissue imbalance promote curve progression. Actually this is physical therapy method which can be defined as a therapy plane of cognitive, sensory motor, and kinesthetic training.^[51]

Scientific exercise approach to scoliosis

As can be understood from the title, this approach is based on scientific principles. This is an extension of Lyon approach which is based on four principles including improving the patient's awareness of their deformity, autonomous correction by the patients, use of exercise to stimulate a balanced reaction, and use of in brace scoliosis specific exercise.^[52]

Schroth method

Actually, this method was developed in Germany in 1927 by Katrina Schroth. This is a method to correct the scoliosis in three dimensions. It was aimed to reduce the incidence of scoliosis progression, reduce postural rotation, improve mobility, improve postural stability, reduce pain, and improve cardiopulmonary function in scoliosis.^[53]

There are some evidences in the literature regarding the effects of these exercises on scoliosis correction. Footwear, wedge, and insoles are the other conservative approaches used for the patients with scoliosis. This is based on this theory that incongruity of pelvis, especially sacroiliac joint, can induce deformation of lower extremity which finally lead to scoliosis.^[54,55] However, there is no evidence regarding the effectiveness of this method.

Functional electrical stimulation

Although the development of this method returned to around 1980, it seems to be ineffective in treatment of scoliosis. At present, the results of some studies showed that if FES combine with other exercise or brace, it may be more effective.^[12,56]

Acupuncture

Actually, sharp and sensitive needles are used to stimulate a certain part of body. It used most often in Chinese medicine also for scoliosis and to reduce the pain associated with low back pain. Based on the available literature, it is too difficult to reach a strong conclusion regarding the effects of acupuncture on scoliosis.^[12,57]

CONCLUSION

Various methods of conservative approaches have been used for the patients with scoliosis. Among these methods, use

of various braces is one of the acceptable methods which not only helps reduce the scoliosis progression but also may decrease it. Various types of orthoses and exercise approaches have been introduced in this paper. It seems that comparison between various conservative approaches and between various orthoses used are the important questions which can be further studied based on the available literature.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Rogala EJ, Drummond DS, Gurr J. Scoliosis: Incidence and natural history. A prospective epidemiological study. *J Bone Joint Surg Am* 1978;60:173-6.
2. Ma X, Zhao B, Lin QK. Investigation on scoliosis incidence among 24,130 school children. *Zhonghua Liu Xing Bing Xue Za Zhi* 1995;16:109-10.
3. Janicki JA, Alman B. Scoliosis: Review of diagnosis and treatment. *Paediatr Child Health* 2007;12:771-6.
4. Weinstein SL, Dolan LA, Cheng JC, Danielsson A, Morcuende JA. Adolescent idiopathic scoliosis. *Lancet* 2008;371:1527-37.
5. Balmer GA, MacEwen GD. The incidence and treatment of scoliosis in cerebral palsy. *J Bone Joint Surg Br* 1970;52:134-7.
6. Goldberg CJ, Moore DP, Fogarty EE, Dowling FE. Scoliosis: A review. *Pediatr Surg Int* 2008;24:129-44.
7. Asher MA, Burton DC. Adolescent idiopathic scoliosis: Natural history and long term treatment effects. *Scoliosis* 2006;1:2.
8. Aulisa AG, Mastantuoni G, Laineri M, Falciglia F, Giordano M, Marzetti E, *et al.* Brace technology thematic series: The progressive action short brace (PASB). *Scoliosis* 2012;7:6.
9. de Mauroy JC, Lecante C, Barral F. "Brace technology" thematic series – The Lyon approach to the conservative treatment of scoliosis. *Scoliosis* 2011;6:4.
10. Goldberg B, Hsu JD, American Academy of Orthopaedic Surgeons. *Atlas of Orthoses and Assistive Devices*. 3rd ed. St. Louis: Mosby; 1997. p. xvi, 704.
11. Bettany-Saltikov J, Parent E, Romano M, Villagrasa M, Negrini S. Physiotherapeutic scoliosis-specific exercises for adolescents with idiopathic scoliosis. *Eur J Phys Rehabil Med* 2014;50:111-21.
12. Kim HS. Evidence-based of nonoperative treatment in adolescent idiopathic scoliosis. *Asian Spine J* 2014;8:695-702.
13. Hsu JD, Michael JW, Fisk JR, American Academy of Orthopaedic Surgeons. *AAOS atlas of orthoses and assistive devices*. Philadelphia: Mosby/Elsevier; 2008.
14. Grivas TB, Kaspiris A. European braces widely used for conservative scoliosis treatment. *Stud Health Technol Inform* 2010;158:157-66.
15. Negrini S, Minozzi S, Bettany-Saltikov J, Zaina F, Chockalingam N, Grivas TB, *et al.* Braces for idiopathic scoliosis in adolescents. *Cochrane Database Syst Rev* 2010;(1):Cd006850.
16. Carr WA, Moe JH, Winter RB, Lonstein JE. Treatment of idiopathic scoliosis in the Milwaukee brace. *J Bone Joint Surg Am* 1980;62:599-612.
17. Canavese F, Kaelin A. Adolescent idiopathic scoliosis: Indications and efficacy of nonoperative treatment. *Indian J Orthop* 2011;45:7-14.
18. Maruyama T. Bracing adolescent idiopathic scoliosis: A systematic review of the literature of effective conservative treatment looking for end results 5 years after weaning. *Disabil Rehabil* 2008;30:786-91.

19. Hopf C, Heine J. Long-term results of the conservative treatment of scoliosis using the Chêneau brace. *Z Orthop Ihre Grenzgeb* 1985;123:312-22.
20. Cinnella P, Muratore M, Testa E, Bondente P. The treatment of adolescent idiopathic scoliosis with Cheneau brace: long term outcome. *Scoliosis* 2009;4:O44.
21. Zaborowska-Sapeta K, Kowalski IM, Kotwicki T, Protasiewicz-Faldowska H, Kiebzak W. Effectiveness of Chêneau brace treatment for idiopathic scoliosis: Prospective study in 79 patients followed to skeletal maturity. *Scoliosis* 2011;6:2.
22. Rigo M, Gallo D. A new RSC brace design to treat single long thoracic scoliosis. Comparison of the in-brace correction in two groups treated with the new and the classical models. *Scoliosis* 2009;4:O46.
23. Weiss HR, Werkmann M, Stephan C. Correction effects of the ScoliOlogiC® “Chêneau light” brace in patients with scoliosis. *Scoliosis* 2007;2:2.
24. Weiss HR, Werkmann M. “Brace technology” Thematic series – The ScoliOlogiC® Chêneau light™ brace in the treatment of scoliosis. *Scoliosis* 2010;5:19.
25. Weiss HR. “Brace technology” thematic series – The Gensingen brace™ in the treatment of scoliosis. *Scoliosis* 2010;5:22.
26. Périé D, Sales De Gauzy J, Hobatho MC. Biomechanical evaluation of Cheneau-Toulouse-Munster brace in the treatment of scoliosis using optimisation approach and finite element method. *Med Biol Eng Comput* 2002;40:296-301.
27. Bulthuis GJ, Veldhuizen AG, Nijenbanning G. Clinical effect of continuous corrective force delivery in the non-operative treatment of idiopathic scoliosis: A prospective cohort study of the TriaC-brace. *Eur Spine J* 2008;17:231-9.
28. Zeh A, Planert M, Klima S, Hein W, Wohlrab D. The flexible Triac-Brace for conservative treatment of idiopathic scoliosis. An alternative treatment option? *Acta Orthop Belg* 2008;74:512-21.
29. Veldhuizen AG, Cheung J, Bulthuis GJ, Nijenbanning G. A new orthotic device in the non-operative treatment of idiopathic scoliosis. *Med Eng Phys* 2002;24:209-18.
30. Berteau JP, Pithioux M, Mesure S, Bollini G, Chabrand P. Beyond the classic correction system: A numerical nonrigid approach to the scoliosis brace. *Spine J* 2011;11:424-31.
31. Matthews M, Crawford R. The use of dynamic Lycra orthosis in the treatment of scoliosis: A case study. *Prosthet Orthot Int* 2006;30:174-81.
32. Coillard C, Leroux MA, Zabjek KF, Rivard CH. SpineCor – A non-rigid brace for the treatment of idiopathic scoliosis: Post-treatment results. *Eur Spine J* 2003;12:141-8.
33. Coillard C, Vachon V, Circo AB, Beauséjour M, Rivard CH. Effectiveness of the SpineCor brace based on the new standardized criteria proposed by the scoliosis research society for adolescent idiopathic scoliosis. *J Pediatr Orthop* 2007;27:375-9.
34. Wiemann JM, Shah SA, Price CT. Nighttime bracing versus observation for early adolescent idiopathic scoliosis. *J Pediatr Orthop* 2014;34:603-6.
35. Gepstein R, Leitner Y, Zohar E, Angel I, Shabat S, Pekarsky I, *et al*. Effectiveness of the Charleston bending brace in the treatment of single-curve idiopathic scoliosis. *J Pediatr Orthop* 2002;22:84-7.
36. Dovorany B, Morningstar M. A long-lever spinal orthosis for idiopathic scoliosis: Corrective potential in 10 patients. *Scoliosis* 2013;8 Suppl 2:O53.
37. Yrjönen T, Ylikoski M, Schlenzka D, Kinnunen R, Poussa M. Effectiveness of the Providence nighttime bracing in adolescent idiopathic scoliosis: A comparative study of 36 female patients. *Eur Spine J* 2006;15:1139-43.
38. Janicki JA, Poe-Kochert C, Armstrong DG, Thompson GH. A comparison of the thoracolumbosacral orthoses and providence orthosis in the treatment of adolescent idiopathic scoliosis: Results using the new SRS inclusion and assessment criteria for bracing studies. *J Pediatr Orthop* 2007;27:369-74.
39. Donzelli S, Zaina F, Lusini M, Minnella S, Respizzi S, Balzarini L, *et al*. The three dimensional analysis of the Sforzesco brace correction. *Scoliosis Spinal Disord* 2016;11 Suppl 2:34.
40. Negrini S, Marchini G, Tessadri F. Brace technology thematic series – The Sforzesco and Sibilla braces, and the SPoRT (Symmetric, Patient oriented, Rigid, Three-dimensional, active) concept. *Scoliosis* 2011;6:8.
41. Grivas TB, Bountis A, Vrasami I, Bardakos NV. Brace technology thematic series: The dynamic derotation brace. *Scoliosis* 2010;5:20.
42. Weiss HR, Werkmann M. Soft braces in the treatment of Adolescent Idiopathic Scoliosis (AIS) – Review of the literature and description of a new approach. *Scoliosis* 2012;7:11.
43. de Mauroy JC, Lecante C, Barral F, Pourret S. Prospective study and new concepts based on scoliosis detorsion of the first 225 early in-brace radiological results with the new Lyon brace: ARTbrace. *Scoliosis* 2014;9:19.
44. de Mauroy JC, Lecante C, Barral F, Daureu D, Gualerzi S, Gagliano R. The Lyon brace. *Disabil Rehabil Assist Technol* 2008;3:139-45.
45. Allington NJ, Bowen JR. Adolescent idiopathic scoliosis: Treatment with the Wilmington brace. A comparison of full-time and part-time use. *J Bone Joint Surg Am* 1996;78:1056-62.
46. Schiller JR, Thakur NA, Ebersson CP. Brace management in adolescent idiopathic scoliosis. *Clin Orthop Relat Res* 2010;468:670-8.
47. Bassett GS, Bunnell WP. Influence of the Wilmington brace on spinal decompensation in adolescent idiopathic scoliosis. *Clin Orthop Relat Res* 1987;2:164-9.
48. Bialek M, M’hango A. “FITS” concept functional individual therapy of scoliosis. *Stud Health Technol Inform* 2008;135:250-61.
49. Coillard C, Circo A, Rivard CH. A new concept for the non-invasive treatment of adolescent idiopathic scoliosis: The corrective movement principle integrated in the SpineCor System. *Disabil Rehabil Assist Technol* 2008;3:112-9.
50. del Campo A. Physical therapy in the treatment of adult and paediatric spinal deformities: The Spinecor method. *Scoliosis* 2010;5 Suppl 1:O31.
51. Jelačić M, Villagrasa M, Pou E, Quera-Salvâ G, Rigo M. Barcelona Scoliosis Physical Therapy School – BSPTS – based on classical Schroth principles: Short term effects on back asymmetry in idiopathic scoliosis. *Scoliosis* 2012;7(Suppl 1):O57.
52. Romano M, Negrini A, Parzini S, Negrini S. Scientific Exercises Approach to Scoliosis (SEAS): Efficacy, efficiency and innovation. *Stud Health Technol Inform* 2008;135:191-207.
53. Weiss HR. The method of Katharina Schroth-history, principles and current development. *Scoliosis* 2011;6:17.
54. D’Amico M. Scoliosis and leg asymmetries: A reliable approach to assess wedge solutions efficacy. *Stud Health Technol Inform* 2002;88:285-9.
55. Hoikka V, Ylikoski M, Tallroth K. Leg-length inequality has poor correlation with lumbar scoliosis. A radiological study of 100 patients with chronic low-back pain. *Arch Orthop Trauma Surg* 1989;108:173-5.
56. Kowalski IM, van Dam F, Zarzycki D, Rymarczyk A, Sebastianowicz P. Short-duration electrostimulation in the treatment of idiopathic scoliosis. *Ortop Traumatol Rehabil* 2004;6:82-9.
57. Ceffa GC, Chio’ C, Gandini G. Muscular tensions of the back studied with telethermography: Changes induced with static measures and auricular acupuncture. Preliminary report. *Minerva Med* 1980;71:899-903.